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JOURNAL SCAN

Journal Scan

Journal of Pediatric Orthopaedics

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Here is my view of the top-10 most potentially influential papers from the Journal of Pediatric Orthopaedics from 2007. Included are the papers that were thought to provide the most useful examinations of treatments and outcomes.

A pilot study of delayed versus immediate serial casting after botulinum toxin injection for partially reducible spastic equinus. Newman CJ, Kennedy A, Walsh M, O'Brien T, Lynch B, Hensey O. *J Pediatr Orthop.* 2007;27:882–885 (Level II, randomized controlled trial).

Context: Spastic equinus commonly afflicts patients with diplegic and hemiplegic cerebral palsy. Hypertonia of the triceps surae may lead to irreversible muscle shortening, requiring surgical lengthening to restore the natural range of motion of the ankle and a more normal gait. Botulinum toxin A is a paralytic agent that temporarily chemically denervates treated muscles through inhibition of the release of acetylcholine at the neuromuscular junction. It is a well-accepted treatment for muscle spasticity, although it has been questioned when the timing is best for botulinum toxin injection of the triceps surae for cases where serial manipulations and casting are planned components of equinus treatment.

Study Design, Results, and Conclusions: This study is a randomized controlled trial of 12 children with spastic diplegia or hemiplegia and mild gastrocnemius and soleus contractures. The patients' gastrocnemius and soleus muscles were injected with botulinum toxin and randomized to either an immediate casting group (weekly casting for 3 weeks) or a delayed casting group (casting 4 weeks after injection, with weekly casting for 3 weeks to follow the delay). Significantly greater mean values for maximum dorsiflexion were obtained in the delayed casting group at 3 and 6 six months after injection.

Comments: These results are important as they support the counterintuitive notion that delay before casting optimizes the ability to stretch the triceps surae with serial manipulations and castings. Limitations of the study include its small sample size (17 limbs in 12 patients), the mixed diagnoses of the patients, and the equivocal results regarding the quality of gait.

Pearls: Patients who were casted immediately had a greater frequency of pain episodes requiring removal of the cast. This study calls to mind the importance of considering the comfort of patients with cerebral palsy, a group with some members who may lack the ability to articulate their feelings.

Does leg lengthening pose a threat to a child's mental health? An interim report one year after surgery. Niemela BJ, Tjernstrom B, Andersson G, Wahlsten VS. *J Pediatr Orthop.* 2007;27:611–617 (Level III, case-control study).

Context: Limb lengthening has been associated with negative psychological reactions in children: a bulky external fixator, to use a child's term, looks "freaky". Younger children, and those with prolonged treatments, inadequate counseling, or poor coping behavior have been noted to be at greater risk.

Study Design, Results, and Conclusions: Twenty-seven patients 6 to 16 years of age with leg-length differences or limb deformity treated with the Ilizarov technique were age

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and gender matched with a control group and tested on various psychological assessments, including the Revised Children's Manifest Anxiety Scale, Children's Depression Inventory, Speedy Performance of IQ I and II, the Child Behavior Checklist, and the Youth Self-Report. No differences in preoperative depression scores existed when comparing groups. Leg lengthening typically resulted in lowering of anxiety and depression scores. No adverse psychological reactions could be identified using the psychological measures in this study.

Comments: Although this study revealed higher anxiety and depression scores in the 10–12 year-old age group, other tests revealed no relationship between patient age and psychological states. Parents of children undergoing lengthening had significant decreases in state scores after the procedures, although otherwise no differences in parent scores and test were identified when comparing groups.

Pearls: To an adult, the long-term benefit of restoring limb-length equality should clearly outweigh the immediate-term costs of treatment. Children, of course, are not characterized by focus on long-term perspectives and ability to defer gratification. Thus, parents may not choose the same course of treatment that their children would, especially in cases when the gains are not realized at once (for instance, surgical procedures that are done to defer or prevent arthritis, as opposed to treat immediate pain). In the case of limb lengthening, preoperative preparation through counseling with the surgeon, psychologists, nurses, and school workers may help a child understand and therefore cope with the treatment.

Effects of early weight bearing on the functional recovery of ambulatory children with cerebral palsy after bilateral proximal femoral osteotomy. Schaefer MK, McCarthy JJ, Josephic K. *J Pediatr Orthop*. 2007;27:668–670 (Level III, retrospective comparative study).

Context: Ambulatory children with cerebral palsy often undergo proximal femoral osteotomy as treatment of excessive femoral anteversion or hip subluxation. Typical postoperative rehabilitation protocols include prolonged immobilization and prohibited weightbearing—a regimen that may prevent immediate failure of fixation, but also may lead to muscle atrophy and generalized osteopenia, not to mention high demands on the patients' caregivers. Early weightbearing without brace or cast immobilization may avoid many of these potential outcomes, although loss of fixation and greater postoperative pain may ensue.

Study Design, Results, and Conclusions: Twelve patients treated between 1999 and 2001 with proximal femoral osteotomy were made nonweightbearing and thus restricted to a wheelchair for 3–8 weeks. Thirteen patients treated between 2001 and 2003 were allowed immediate weightbearing as tolerated. No spica casts were used in either group; one hip orthosis was used in the nonweightbearing group. Charts were reviewed and compared for complications, pain scores, date of standing, type of postoperative casting, and the use of antispasmodic medications. Eight days postoperatively, the early weightbearing group had significantly less pain. Children allowed weightbearing as tolerated also stood an average of 26 days earlier than patients in the delayed weightbearing group. By 13 months, all patients were back to baseline ambulation, although the early mobilization group returned to baseline walking 4 months earlier than patients in the delayed weightbearing group. No loss of fixation was recorded in either group.

Comments: Small groups, a retrospective review, and sequential assignment of patients rather than a randomized protocol limit the interpretation of the data. However, as all procedures were done by one surgeon at one institution with a similar nursing staff and PT protocols, these results are still of great value. This study suggests that not only is cast or brace immobilization unnecessary to maintain postoperative fixation of a proximal femoral osteotomy held with a blade plate, but that early mobilization decreases early pain, inpatient physical therapy duration, and time to ambulation without incurring additional risks.

Pearls: Even without weightbearing, the operative limb is subject to force-bearing (from muscular contracture). Thus, patients who are instructed to remain nonweightbearing may be needlessly restricted. In the adult hip fracture population, it has been suggested that patients can autoregulate the amount of weight to place on the limb and not routinely expose the bone to more force than it can withstand. This study suggests that a similar phenomenon may take place even among young patients with cerebral palsy.

Juvenile osteochondritis dissecans of the talus. Perumal V, Wall E, Babekir N. *J Pediatr Orthop.* 2007;27:821–825 (Level IV, retrospective review).

Context: There are few studies of osteochondritis dissecans of the talus in children. Long-term followup to radiographic healing rarely has been reported. The usual treatment for symptomatic patients is activity modification, with drilling of the lesion if healing is delayed. Time to healing with and without drilling in the skeletally immature has not been reported. Persistent osteochondritis dissecans lesions noted on radiographs in children may lead to overlying cartilage destruction and loose bodies in adults. The natural history of these unhealed lesions is not known.

Study Design, Results, and Conclusions: The records of 31 patients with open physes and Bernt and Hardy Stages 1–3 osteochondritis dissecans of the talus (63% medial talar dome) followed for a minimum of 6 months were

reviewed for resolution of symptoms and radiographic healing. By 6 months, only 16% had evidence of clinical resolution and complete radiographic healing, whereas 77% had persistent evidence of the lesion on radiographs. Six percent had persistent pain after cast removal and underwent surgery. By 1 year, only an additional 12% showed clinical and radiographic evidence of healing. Almost ½ (42%) underwent surgery for persistent pain and incomplete radiographic healing, whereas 46% had resolution of symptoms without radiographic healing. Surgery, including various treatments such as retrograde drilling, bone grafting, and bone marrow injection, was performed on patients with persistent pain after 6 months or a year of observation. Surgery resulted in an 85% healing rate at 1 year, although it is unclear which surgical techniques were successful and which did not lead to radiographic healing.

Comments: Though there may be clinical resolution of symptoms with 1 year of rest in the presence of nondisplaced osteochondritis dissecans of the talus, radiographic healing occurs in less than ⅓ of patients through rest and activity modification. When considering the investment of time with such low healing rates, earlier surgery may be warranted in this condition. Limitations of this study include its retrospective nature and variety of surgical treatments used for various indications.

Pearls: Arthroscopic treatment of osteochondritis dissecans of the talus is minimally invasive, allowing for retrograde or antegrade drilling of lesions. The opportunity costs of delayed treatment make early treatment of symptomatic lesions an attractive alternative and should be presented to those providing informed consent.

Arthroscopic findings at the time of patellar realignment surgery in adolescents. Luhmann SJ, Schoenecker PL, Dobbs MB, Gordon JE. *J Pediatr Orthop*. 2007;27:493–498 (Level IV, retrospective review, case series).

Context: Patella dislocations are common knee injuries in children and adolescents. Osteochondral fracture of the lateral femoral condyle, chondral injury to the patella, and loose bodies in the knee are common sequelae of patella dislocations. Treatment for the adolescent with recurrent patellar dislocation typically includes lateral release, medialization of the tibial tubercle, and also may include medial reefing or medial patellofemoral ligament repair or reconstruction. Arthroscopy is not commonly considered a part of patellar realignment surgery, but is a reasonable adjunct to the realignment procedure—especially to exclude concomitant diagnoses.

Study Design, Results, and Conclusions: A retrospective review of all patellar realignment surgery including arthroscopy by one surgeon over a 4-year period revealed 38 patients with 41 operated knees. Osteochondral lesions of the patella were seen in 30 knees (73%); of the femur, in 11 knees (23%); and loose bodies were found in six knees (15%). Additional findings in eight patients (20%) included meniscal tears, a discoid meniscus, a partial anterior cruciate ligament disruption, and medial tibiofemoral arthrosis, leading to an additional five procedures in four patients.

Comments: Arthroscopy is a minimally invasive technique for examining the articular surfaces of a joint, and in this case, a joint traumatized by a dislocation event. Patellar dislocations may be accompanied by cartilage damage to the patella or femur. It makes good sense when treating the proximal cause of the dislocation to understand the full extent of the injury, which arthroscopy can do more reliably than MRI or other imaging techniques. This review again is limited by its retrospective nature. Long-term followup with a comparison group not undergoing arthroscopy with patellar realignment surgery would be a better study, but perhaps not reasonable in this day and age.

Pearls: Improved tracking of the patella may be monitored during the stages of patellar realignment surgery, allowing for fine-tuning in the degrees of medialization of the tibial tubercle or reefing/tensioning of medial structures. The operating surgeon must be mindful, however, that in the anesthetized patient, only static stability is assessed: the additional force of the vastus medialis obliquus is not provided by the sleeping patient.

Perioperative complications after surgical correction in neuromuscular scoliosis. Mohamad F, Parent S, Pawelek J, Marks M, Bastrom T, Faro F, Newton P. *J Pediatr Orthop*. 2007;27:392–397 (Level IV, retrospective review, case series).

Context: Scoliosis is prevalent in patients with neuromuscular disorders. Such patients frequently have poor pulmonary function, limited mobility, and osteopenia; all of which increase the risk of complications of scoliosis surgery. In this population, the literature suggests postoperative complication rates ranging from 24%–75% at 2 years. The early perioperative complication rates for scoliosis surgery in this patient population have not been reported previously.

Study Design, Results, and Conclusions: A retrospective review of hospital charts of all patients with neuromuscular conditions undergoing scoliosis surgery in a 17-year period at one institution revealed 175 patients, 58 of whom had 96 complications within the first 3 months after surgery. Forty-five complications were pulmonary, 20 were infectious, seven were cardiovascular, and six were related to instrumentation failure. Four surgeries were unplanned staged procedures, one patient sustained a compartment syndrome without significant sequelae, and one patient had severe

gastroesophageal reflux refractory to medical management that was treated with a laparoscopic Nissen fundoplication and gastrostomy 10 days after spinal surgery. Eight patients had somatosensory evoked potential monitoring changes intraoperatively, including one patient whose changes were followed by revision of instrumentation, although no patient had identifiable permanent neurologic changes thought to be a result of the surgery. Two patients had pseudarthroses and two patients has unlisted "miscellaneous" complications.

Risk factors identified as associated with complications included a history of seizures, almost 2 L blood loss (vs. 1 L blood loss average for those without complications), and unplanned staged procedures. A longer operative time tended toward a greater complication rate, including a greater infection rate for posterior spinal instrumentation and fusions; fusion down to the sacrum also tended toward a greater complication rate, although none of these associations were statistically significant. Patients with gastrostomy tubes did not have a different complication rate than those without feeding tubes.

Comments: This study reinforces previous reports of a high rate of complications associated with scoliosis surgery in the neuromuscular patient population. Infections were less common (8% overall, with a deep wound infection rate of 1%) than previously reported, although numerous similar studies include a minimum of 2 years followup, whereas this study only reported complications within 3 months of surgery. Intraoperative changes in somatosensory evoked potentials were noted in multiple patients in this review; the authors recommend monitoring despite the difficulty that may be encountered in performing reliable monitoring in this patient population, and the fact that subtle differences in neurologic function postoperatively are difficult to discern. Nonetheless, the authors argue that performing intraoperative monitoring may have avoided major neurologic injury, and they recommend its routine use.

Pearls: Approximately one in three patients with neuromuscular conditions undergoing scoliosis surgery sustained a complication within 3 months of surgery, with an average of nearly two complications per patient. The decision to perform scoliosis surgery in patients with neuromuscular conditions must be deliberate, with clear consideration of the potential benefits, given the high costs of risk exposure alone.

Treatment of open femur fractures in children: comparison between external fixator and intramedullary fixation. Ramseier LE, Bhaskar AR, Cole WG, Howard AW. *J Pediatr Orthop.* 2007;27:748–750 (Level III, comparative cohort study).

Context: Open femur fractures are at increased rate of infection, compared with those where the skin and soft tissue envelope remain intact. As such, many practitioners avoid intramedullary fixation so as to decrease the risk of infecting hardware. External fixation of such fractures may allow stabilization without instrumenting in the region of the open fracture, although it may not reduce and hold the bone optimally (not to mention the risks of pin complications). A comparison between these two treatments will help establish the relative risks of each treatment in this patient population.

Study Design, Results, and Conclusions: A retrospective chart review over 17 years at one institution identified 35 skeletally immature patients with open femur fractures treated with intramedullary fixation (12 patients) or external fixation (23 patients). All open fractures underwent irrigation and debridement, and IV antibiotics were continued until soft tissue closure was achieved. The choice of stabilization method was left to physician preference. Gustilo-Anderson grades were recorded, with no significant difference in the breakdown of grades by treatment group. Patient ages also were comparable between groups, as were levels of the fracture, mechanisms of injury, and fraction of patients with polytrauma. Time to union was significantly shorter in the intramedullary fixation group (10 weeks vs. 16 weeks; $p = 0.02$); overall complications were more common in the external fixator group (21 of 23 vs. three of 12; $p = 0.04$), although after excluding pin tract infections, there was not a significant difference in infection rates (16 of 23 vs. three of 12; $p = 0.20$.) There were six refractures in the external fixation group and none in the intramedullary group, although this did not reach statistical significance ($p = 0.06$).

Comments: Although we now understand that IM nailing of open femur fractures in adults has comparable complication rates to other treatment methods, this is the first study in children to suggest flexible intramedullary nailing of open femur fractures has lower complication rates and faster healing than treatment by external fixation. Varus malunion may predispose a femur treated with external fixation to refracture. Careful establishment of alignment and protection during the first 6 weeks after fixator removal may be keys to avoid refracture.

Pearls: Do not be a slave to the $p = 0.05$ criterion. Here, there were six refractures in the external fixation group and none in the intramedullary group. The p value was "only" 0.06. That should be good enough. A foolish consistency is the hobgoblin of small minds, as Emerson noted.

Surgical treatment of unresolved Osgood-Schlatter disease: ossicle resection with tibial tubercleplasty. Weiss JM, Jordan SS, Andersen JS, Lee BM, Kocher M. *J Pediatr Orthop.* 2007;27:844–847 (Level IV, retrospective review, case series).

Context: Osgood-Schlatter apophysitis is a painful condition typically affecting preteens but residua of the

condition may produce symptoms in teenagers as well. In these patients, persistent tenderness from semimobile ossicles in the patellar ligament is found even after skeletal maturity. The mainstays of treatment are nonoperative, however surgical resection of prominent and painful ossicles may be necessary to alleviate symptoms. Patients also may dislike the tibial tubercle prominence that often remains at skeletal maturity; tibial tubercleplasty may improve satisfaction with surgical intervention.

Study Design, Results, and Conclusions: A retrospective review of all patients treated for Osgood-Schlatter disease at one institution during a 15-year period revealed approximately 3600 patients, 51 who had surgical treatment, 15 of whom were included in the study. Bump size was decreased in 11 of 16 knees, average pain scores were below the midpoint on all three rating scales, and 12 of 15 patients returned to their preoperative activity levels.

Comments: It is noteworthy that less than 2% of patients seen for Osgood-Schlatter apophysitis in a specialized sports medicine practice underwent surgery for persistent symptoms. As the majority of patients with this condition are likely treated by primary care physicians, this suggests an even smaller fraction of all patients with the condition who would benefit from surgery. All patients in this study underwent ossicle resection and tibial tubercleplasty. A randomized study examining the contributions of both procedures to pain relief, cosmesis, and return to activity would be ideal, although the small number of patients ultimately treated for the condition makes such a study impractical. As the surgery is performed through a split in the patellar ligament that is repaired, the risks of performing ossicle resection and tibial tubercleplasty are likely quite low. No complications were reported in this study, however, one of 15 patients reported a larger bump after the first surgery that was successfully removed during reoperation. A second patient reported no change in symptoms and bump size and declined additional surgery.

Pearls: It is possible that the beneficial effects of this operation are mediated by a placebo effect; especially since the patient can easily see a change in the size of the tubercle. That said, it may be medically and cost effective to perform this procedure, in comparison to many years of symptoms and consumption of nonoperative medical resources. As noted above, early surgery for patients with chondral lesions in the ankle avoids the high opportunity costs of delayed treatment. Nonetheless, until we can better identify the risk factors for chronic symptoms, Osgood-Schlatter apophysitis should be considered a nonoperative condition, as it was for 98% of the patients in this study.

A systematic review of medial and lateral entry pinning versus lateral entry pinning for supracondylar fractures of the humerus. Brauer CA, Lee BM, Bae DS, Waters PM, Kocher MS. *J Pediatr Orthop.* 2007;27:181–186 (Level III, systematic review of the literature, therapeutic study).

Context: More than 200 articles have been published on supracondylar fractures of the humerus during the past 10 years. This systematic review carefully examines the literature, summarizing the results of 68 reports of more than 2000 children regarding the outcomes comparing two techniques of closed reduction and pinning of these fractures.

Study Design, Results, and Conclusions: All randomized trials (two), prospective (six) and retrospective (27) cohort studies between 1996 and 2004 of displaced supracondylar humerus fractures treated with two medial and lateral crossed or two lateral pins, were compared for iatrogenic nerve injury, deformity and/or loss of reduction. The technique of medial and lateral pin entry had a statistically higher probability of any iatrogenic nerve injury (1.8 times, 3.5 vs. 1.9%) than lateral-only pin entry, and a five times greater risk of ulnar nerve injury (3.4% vs. 0.7%). Medial and lateral cross pin entry was found to have 0.58 times the risk of deformity or loss of reduction, significantly less than the lateral entry pinning group.

Comments: Although this systematic review found a difference in outcomes with these two techniques, no randomized control trial (three published to date) has identified a significant difference in any of these outcome measures. That may be because the randomized trials have groups too small to identify a significant difference in outcomes, or that these randomized trials used greater care in medial pin placement, with, for example, mini-open approaches, or tests of stability of lateral-only pin entry placement before accepting these constructs.

Pearls: If you are confused about the apparent contradiction between the results listed here and those of the randomized trials, consider the plight of Dr. Kocher (one of the coauthors here). He was the first author of a recent article in which no iatrogenic nerve injury occurred from the placement of medial pins. Note also the difference in relative versus absolute risks: for an increase from 1.9% to 3.5%, one could say that "the risks are nearly doubled!" or, equally, "risks were increased only 1.6%".

Percutaneous pinning of pediatric supracondylar humerus fractures with the semisterile technique: the Miami experience. Iobst CA, Spurdle C, King WF, Lopez M. *J Pediatr Orthop*. 2007;27:17–22 (Level IV, retrospective review of surgical technique).

Context: Supracondylar humerus fractures are commonly treated with closed reduction and pinning. Although many studies address pin configuration and outcomes (see above), the infrequency of the need for open reduction suggests the use of semisterile techniques of operative treatment, to limit waste of materials and manpower.

Study Design, Results, and Conclusions: Three hundred four patients with a closed supracondylar fracture of the humerus were treated with closed reduction followed by semisterile prepping, draping, and pinning. The procedure is performed in the operating room with the patient under general anesthesia. Closed reduction is performed using fluoroscopic guidance, an assistant holds the arm to maintain the reduction, the surgeon dons sterile gloves and places sterile towels around the surgical field, prepares the elbow locally in the anticipated area of pin sites, and then pins the fracture with fluoroscopic assistance. No superficial or deep pin tract infections were reported.

Comments: As costs for medical care continue to soar, using clinical pathways that decrease the use of materials and minimize operative times and hospital stays are essential. This technique for the care and treatment of patients with closed supracondylar humerus fractures will save money by eliminating the use of draping packs, large instrument sets, and gowns for surgeons, decreasing overall operative times. It is likely careful prepping, draping with towels, and careful manipulation of pins and drivers contributed to the low (zero) infection rate. Although the authors suggest that because 68% of patients received no perioperative antibiotics and there were no infections in the group, perioperative antibiotics may not be necessary for this procedure, the cost of this element of treatment seems low enough to justify its continued use.

Pearls: It is difficult to justify even a theoretical risk of complication to save the cost of a medical expense: surgeons are their patients' agents. Yet as the authors here suggest, the streamlined semisterile technique may allow the case to be completed faster, which in turn may facilitate getting the patient to the operating room sooner—as most of these cases are done as an add on. Overall, a patient may do better with a rapidly performed semisterile technique as opposed to a fully draped case 10 hours later, if that.